

REMARKS

Introduction

This is responsive to the Office Action dated April 14, 1992. Claims 4-7 have been rejected under 35 U.S.C. 112, second paragraph, and in view of the prior art.

The Examiner stated that certain portions of claims 6 and 7 were not clear. These claims have been amended so as to satisfy the Examiner's requirements. The 35 U.S.C. 112, second paragraph, rejection is requested to be withdrawn.

Claims 4-7 were rejected as being obvious over either the Muller reference; or, alternatively, a combination of Baines, Strobl or Campbell in view of Muller. The prior art rejection was discussed in an interview between the Examiner and the undersigned on August 27, 1992, but no agreement was reached.

The Examiner cited Muller (Fig. 3) as teaching wiper arms, which, in his view, are analogous to brushes and support arms for brushes in a motor. The Muller reference states that the wiper arms have different resonant frequencies. Therefore, in the Examiner's view, it is obvious to modify the brushes in the primary references, so as to have different resonant frequencies.

Muller's Teachings Are Irrelevant to This Invention

The Muller reference is irrelevant to the claimed invention. Muller was concerned with solving a different problem than that solved by the present invention.

Claims 7 and 18, and 33 specify that the first and second supports or support arms are mounted so as to be spaced axially with respect to the rotating commutator at the axis of the motor.

The problem to be solved is keeping at least one of the first and second axially-spaced brushes in good contact with the given commutator portion at a given time. With the invention, since the first and second support/brush combinations have different resonant frequencies, then even if the commutator is somewhat irregular and the brushes are bouncing along its

surface, they will not be bouncing at the same frequency and therefore one of the brushes will most likely be in contact with a given circumferential portion of the commutator at a given time, which is highly advantageous for maintaining proper operation of the motor.

There is no such axial spacing of the wiper arms in Muller. Muller never considered the problems of maintaining axially spaced brushes in contact with a motor commutator. Therefore, Muller cannot disclose any relevant teachings for solving that problem.

Further, claims 7, 15, 17, 19-20 and 23 specify that the claimed first and second (or third and fourth) brushes are for contacting the same circumferential segment or region of the commutator, that is, for contacting the commutator at substantially the same position around its circumference. In Muller, the two wiper arms are not at the same circumferential location around the rotating shaft. (They are not even at opposite locations on the shaft.)

Even if Muller were combined with the primary references, for example with the Campbell reference as the Examiner has proposed, such a combination would not have the features now claimed. In such a combination, the first and second brush/support arm combinations might well have the same resonant frequency, contrary to the express requirements of claims 7, 17, and 33 and the dependent claims. Muller's teachings at most relate to wiper arms which engage different circumferential portions of a rotating shaft. Muller teaches nothing about wiper arms or motor brushes in the arrangement of claims 7, 17, and 33. If Muller were combined with the primary references, even assuming such a combination were proper, Muller would teach at most that a brush on one side of a motor commutator should have a different resonant frequency from that of a brush on another side of the commutator. In the arrangement set forth in the independent claims, this would mean that the first and second brushes might well have the same frequency as each other. Such a result is not ruled out by Muller.

If there were third or fourth brushes on a different side of the commutator from the first and second brushes, the third and fourth brushes would also have the same frequency as each other. The limit of Muller's teachings, for the sake of argument, is that the frequency of the third and fourth brushes should be different from that of the frequency of the first and second brushes.

Furthermore, Muller does not even teach a relationship for resonant frequencies of wiper arms on diametrically opposite sides of a rotating shaft. As clearly shown in Fig. 3 of Muller, according to basic trigonometry, the contact points of the wiper arms on the rotating shafts will not be diametrically opposite to each other, but will both be slightly displaced in the direction toward the left as shown in Fig. 3 of Muller.

For at least the above reasons, the Muller reference, even in combination with the primary references, neither discloses nor suggests the invention as now claimed. An alternate ground for rejection was based on the Muller reference alone. That rejection is respectfully traversed for the reasons already discussed.

Muller's Frequency-Setting Technique Teaches Away from the Invention

The different resonant frequencies in Muller are obtained by providing the wiper arms with different lengths. Even assuming that Muller could be combined with the primary references, nothing in Muller can suggest the features of claim 33, which specifies that the first and second support arms have substantially the same length. In fact, Muller teaches away from this invention.

Nor can Muller suggest the subject matter of claims 5, 6, 8-13, and 24-31, which state that the different resonant frequencies of the support/brush combinations are obtained by different shapes or sizes or densities of the brush, or different resiliencies of the support, which are obtained, for example, by

providing a slot or a different dimension of at least one of the supports.

Nor can Muller suggest claims 24-31, which specify that at least one of the first brush and the first support has adjusting means for causing the first frequency to be different from the second frequency. Even if the features of the prior art resulted in particular frequencies as the Examiner has alleged, the prior art suggests no such "adjusting means" as claimed.

Muller's Teachings as to Wiper Arm Length
Are Irrelevant to the Invention

Further, the teachings of Muller are not significant in the field of brushes for a dc motor. The natural frequency of the brush/support combination is essentially determined by the resiliency of the support and/or the weight of the brush. The weight of the brush is by far the most significant part of the overall weight of the support arm together with the brush. Adjusting the length of the support arm would have very little practical effect. The natural resonant frequency of the brush/support arm combination would be virtually unaltered by having different arm lengths, bearing in mind that the support arms are supported at substantially the same radial distance from the axis of the motor.

In other words, in the context of a dc motor, a resilient support arm pressing a brush body against a commutator is much more dependent for its natural frequency on the actual flexibility of the arm and the actual weight of the brush, than on the length of the arm itself. The solution proposed by Muller would be essentially useless in the context of a dc motor, and in fact is not employed according to the present invention, as defined in the claims.

The only reason Muller would have any practical applicability, if it does, is that its wiper arms do not have relatively heavy brush bodies at their ends.

Thus, the Muller reference teaches away from the solution claimed in claim 33, which specifies that the support

arms have substantially the same length. The Muller reference teaches, at most, setting natural frequencies by providing Muller's wiper arms with different lengths.

It also teaches away from the invention of claims 7 and 17 which includes a support and a brush, because Muller's arrangement would be useless for its intended purposes if a relatively heavy brush were somehow grafted onto Muller's wiper arms.

Thus, a skilled individual, reviewing the Muller reference, would discount the Muller reference, since it teaches a useless solution in the context of a dc motor.

Muller and Campbell are not Comparable as Proposed by the Examiner

Of the prior art relied on most heavily by the Examiner, Baines (U.S. 4,728,835), Strobl (U.S. 4,983,872) and Muller (U.S. 3,671,791), not one reference is concerned with the provision of two or more brush contacts for electrical engagement with a rotating cylindrical body, such as a commutator or a slip ring, for the purpose of supplying an electric motor with higher current without increasing current density at the interface between the stationary contacts and the rotating cylindrical body.

Although Muller discloses the use of a wiper member 13 having two contact arms 6, the purpose of the wiper member 13 is merely to provide an electrical connection between a fixed contact pin 5 and the rotating slip ring 7 of a function generator. The provision of the wiper member 13 with two arms is solely for the purpose of providing the wiper member 13 with a "U-shaped end portion" (see line 10, column 1) which (as explained at lines 50 to 54, column 2) can be formed into a C-shaped end 14 for attaching the wiper member 13 to the pin 5. As the wiper member 13 is merely required to engage the slip ring 7 of a function generator 8, there is no disclosure of any advantage to be obtained in providing multiple brushes for

reducing current density at the interface between the wiper member 13 and the slip ring 7, as in the present invention.

In fact, the assembly disclosed by Muller will function perfectly well even when the wiper member 13 has only one leg engaging the slip ring 7. This is clear from the disclosure at lines 27 to 31, column 2, where it is explained that the additional use of solder to fasten the wiper member 13 to the pin 5 improves operation even "if one arm breaks" so that the only engagement is provided by the other arm.

Campbell (U.S. 3,041,118) does show an assembly in which armature current in an electric motor can be increased without increasing current density at the interface between the stationary and rotating parts by utilizing two brushes mounted, respectively, on two brush arm portions. However, Campbell teaches nothing about the advantages of providing two brush-arms assemblies having different resonant frequencies. In fact, the two brush arm portions of the apparatus disclosed by Campbell are merely bifurcated end portions of a single leaf spring 16 which are coupled together, throughout a substantial part of the tangential extent of these two brush arm portions, in such a way as to inhibit the possibility of independent vibration of the two brush arm portions.

Even if this fundamental point were to be disregarded, for the sake of argument, there are equally cogent reasons which make it clear, to an individual skilled in the art, that it would not be reasonable to modify Campbell to provide brush arm portions of different lengths, as clearly specified in Muller, in order to produce two brush-arm assemblies having different resonant frequencies.

That is, the main problem addressed by Campbell is to solder carbon brushes 24 respectively to the two identical brush arm portions of the leaf spring 16 in such a way as to avoid the adverse effects of high-temperature and high-vibration operating conditions and, in particular, to provide the leaf spring 16 with a layer of material, such as "forneco" (see claim 1), which is compatible with the material of the leaf spring 16, the carbon

brushes 24 and the soldering and bonding materials 22, 26 and 28 which hold these components together and which have sufficiently similar coefficients of thermal expansion to prevent the relative distortions and resultant fractures of prior art assemblies.

According to Campbell, this well defined problem is resolved by a construction which includes cladding each of the free ends of the two brush arm portions of the bronze leaf spring 16 with a U-shaped forneco strip (as stated in the claim).

According to the description at lines 16 to 27, column 4, feasible alternatives to the U-shaped cladding of the free extremities of the brush arm portions involve difficulties and so, to avoid the precautions necessary to overcome these difficulties, these alternatives to the U-shaped cladding are not recommended.

The teaching of Campbell is therefore directed to:

the attachment of carbon brushes to the free ends of two equal-length brush arm portions, for engagement with axially spaced portions of the cylindrical surface of a slip ring 12;

a construction in which independent vibration of the two brush arm portions is inhibited; and

a construction in which the prospect of lengthening one of the brush arm portions so as to make it longer than the other brush arm portion is nowhere foreshadowed for any purpose whatever, and would necessarily involve acknowledged but indefinable problems in preserving the absence of unwanted, fracturing distortions under the high-temperature, high-vibration operating conditions envisaged/envisioned.

Thus, a hypothetical combination of the disclosures of Muller and Campbell does not follow logically and is not foreshadowed in either of the patent specifications.

Conclusion

For all the above reasons, allowance of claims 7-33 is requested.

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James A. Finder

Name of applicant, assignee or
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Signature

October 14, 1992

Date of Signature

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Respectfully submitted,



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